



Short communication

## Adapting *ProNutra* to interactively track food weights from an electronic scale using *ProNESSy*

Rick Weiss<sup>a,\*</sup>, Alice K.H Fong<sup>b,1</sup>, Mary J. Kretsch<sup>b</sup>

<sup>a</sup> Princeton Multimedia Technologies Corp., 145 Witherspoon Street, Princeton, NJ 08542, USA

<sup>b</sup> US Department of Agriculture, Agricultural Research Service, Western Human Nutrition Research Center, University of California, Davis, CA 95616, USA

Received 11 October 2002; received in revised form 17 March 2003; accepted 27 March 2003

---

### Abstract

To overcome the limitations of current dietary assessment methodology, scientists at the USDA, ARS, Western Human Nutrition Research Center (WHNRC) developed a computerized food-scale system named NESSy, Nutrition Evaluation Scale System (US Patent #5,233,520). WHNRC and Princeton Multimedia Technologies (PMT), through the USDA Technology Transfer program, have a cooperative research and development agreement to commercialize products based upon NESSy. The first product, *ProNESSy*, allows dietetic professionals the capability to track weighed food intakes for research subjects participating in clinical, metabolic, and/or free-living research studies.

*ProNESSy* is a software module that works with *ProNutra*, PMT's dietary analysis system that supports research dietitians. While *ProNutra* facilitates diet design, *ProNESSy* facilitates accurate dietary kitchen food processing as well as accurate and timely reporting of the food/nutrient intake from such studies. Dietitians use *ProNutra* to plan, manage, and analyze food and nutrient intake while dietary kitchen staff use *ProNESSy* to accurately weigh and track foods prepared for research studies. Together, the two software modules provide health care researchers the unique ability to design precise nutrient-intake studies and to efficiently measure, manage, and monitor the preparation and consumption of the provided foods and nutrients.

*ProNESSy* runs on a PC with a touch-sensitive screen connected to an electronic scale. *ProNESSy* converts study diets into detailed electronic step-by-step instructions to direct the diet preparation. The "Weigh-In" mode, used during diet assembly, ensures that each subject is served the correct weight of specified foods. The "Weigh-Out" mode is used to determine actual intake by weighing any uneaten food(s). Extensive error detection and prevention techniques are used to prevent errors.

© 2003 Elsevier Science Ltd. All rights reserved.

**Keywords:** Nutrition calculation software; Metabolic studies; Clinical studies; Dietary intake; Humans

---

---

\*Corresponding author. Tel.: +1-609-497-4600.

E-mail address: weiss@viocare.com (R. Weiss).

<sup>1</sup> Formerly with USDA, Western Human Nutrition Research Center.

## 1. Introduction

Scientists at the USDA, Agricultural Research Service's Western Human Nutrition Research Center (WHNRC) developed and patented a computerized food scale system named NESSy, the acronym for Nutrition Evaluation Scale System (Kretsch, Gunn, & Fong, 1993). Prototypes for two versions of NESSy were developed and tested for accuracy and time savings (Kretsch & Fong, 1990, 1993; Fong & Kretsch, 1990) at the WHNRC: NESSy for the layperson (*Consumer NESSy*) and NESSy for dietetic professionals (*ProNESSy*). While the infrastructure of both NESSy versions is similar, the computer–user interfaces of the two versions are structured to meet the unique needs of each application. *ProNESSy* has the capability to track weighed food intakes for multiple research subjects in clinical, metabolic, and/or free-living research studies (Kretsch & Fong, 1990, 1993).

*ProNutra*, a nutrient calculation and food management software system, was developed to support metabolic and clinical research studies. Development of *ProNutra* was supported through several Small Business Innovation Research (SBIR) grants from the National Center for Research Resources (NCRR) at the National Institutes of Health (Weiss, 2000, 2001). Because the WHNRC participated in developing the *ProNutra* specifications, the NESSy inventors were familiar with its capabilities. They recognized that the NESSy technology could expand *ProNutra's* capability to interface with dietary kitchen personnel, thereby improving and providing time savings for metabolic and clinical feeding studies. The USDA Office of Technology Transfer encourages cooperative research and development agreements (CRADAs) between USDA scientists and industry to commercialize patented inventions. To this end, the WHNRC and Princeton Multimedia Technologies Corp. (PMT) have worked together through a CRADA to produce a new *ProNESSy* module to complement *ProNutra*. Because *ProNESSy* automates the dietary kitchen's food-weighing operations, these two software systems together are capable of streamlining all dietetic processes from planning a metabolic/clinical feeding study to summarizing the results.

This paper describes the set of enhancements made to *ProNutra*, allowing it to fully support the *ProNESSy* operation, and gives a brief overview of the latest version of *ProNESSy* operational on state-of-the-art technology. Although the weighed food component of this integrated software system is based upon the NESSy invention, that has been subjected to rigorous validity testing (Kretsch & Fong, 1990, 1993), accuracy and labor-saving benefits of the new *ProNutra* and *ProNESSy* software system are currently being studied. Thus, these aspects will be reported in a future publication.

## 2. System description

### 2.1. Equipment

Whereas *ProNutra* runs on the research dietitian's computer, *ProNESSy* runs on a workstation within the dietary kitchen. Dietary instructions for the kitchen staff are generated through a connection to the *ProNutra* database that stores the food descriptions and food-weighing details for each subject. Both software systems are operational under Windows® (see Fig. 1).

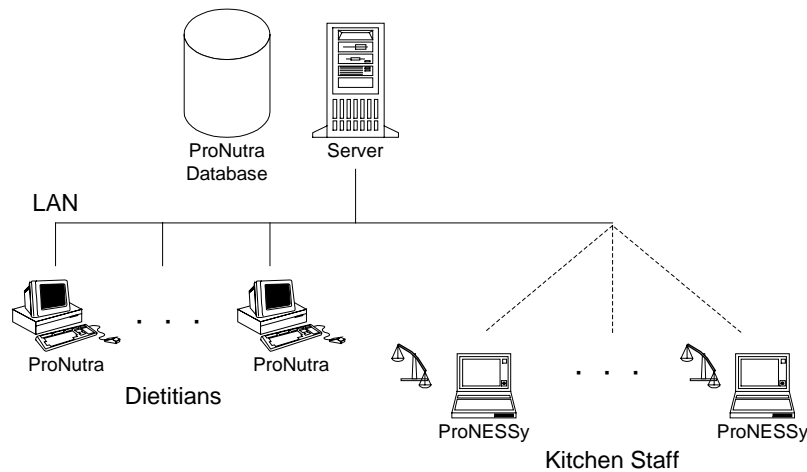


Fig. 1. ProNESSy configuration.

Each *ProNESSy* workstation consists of the following:

- *ProNESSy* software module;
- computer, ideally with touch-sensitive LCD monitor and ruggedized keyboard;
- LAN adapter for connecting to the *ProNutra* database—option of using wireless communication;
- electronic scale with RS232 interface and cable.

*ProNESSy* registers food weights by communicating with an electronic scale through an RS232 port. Pairing the computer with a touch-sensitive LCD monitor has the advantage of yielding quicker interactions than possible with a computer keyboard and/or mouse. Another advantage of using the touch-sensitive screen is that many kitchen staff members might not be comfortable using a computer mouse, but most have had experience using touch-sensitive screens at bank ATMs or store information kiosks. It is also easily cleaned due to the lack of crevices and moving parts where food can lodge. The standard keyboard can also be replaced with a ruggedized one that is sealed to prevent failure from potential liquid and food spills and is designed to withstand rough handling, such as dropping the keyboard. Ruggedized laptop computers can also be used; they have the added advantage of portability.

## 2.2. *ProNutra*: adaptations to support *ProNESSy*

The research dietitian initially uses *ProNutra* to plan, assign, and schedule the menus for each of the subjects within a metabolic/clinical feeding study. Enhancements were developed within *ProNutra* to support the integrated *ProNESSy* technology. These features augment the dietitian's ability to define and control how the dietary kitchen staff processes and weighs foods. Besides using *ProNutra* to define a subject's foods and food-serving weights for a specific study day, the research dietitian can also establish the container for each food, how closely the food weight must match the planned serving weight (precision value), the "Weigh-In" process for each food,

whether a weighing or counting process will be used (the latter is a time-saving option for use with prepackaged foods of a standard weight), and whether to serve foods in individual containers or as multiple foods upon a single container, i.e. “combo food”. This latter feature allows the dietitian control over the “presentation” of foods.

### 2.3. ProNESSy: a brief overview

The primary features of *ProNESSy* include:

- step-by-step instructions to direct food weighing by the kitchen staff;
- “Weigh-In” processing;
- “Weigh-Out” processing;
- error detection and prevention;
- weigh status reports.

*Weigh-In*: The first step in the Weigh-In process is defining what foods to process by selecting only the meals and the production types assigned by the dietitian. Next, *ProNESSy* provides instructions to place either a specific container or food on the scale. Once the system registers the container or food weight, it then provides direction to the user for the next step (see Fig. 2).

This process continues until all weights have been automatically recorded into the computer’s memory. This combination of action and inquiry is repeated for every food entered into *ProNutra* by the dietitian (see Fig. 3). In addition to screen images and text, the system also responds with audio signals to ensure correct actions are taken when performing the instructions, such as removing items from the scale before processing the next food.

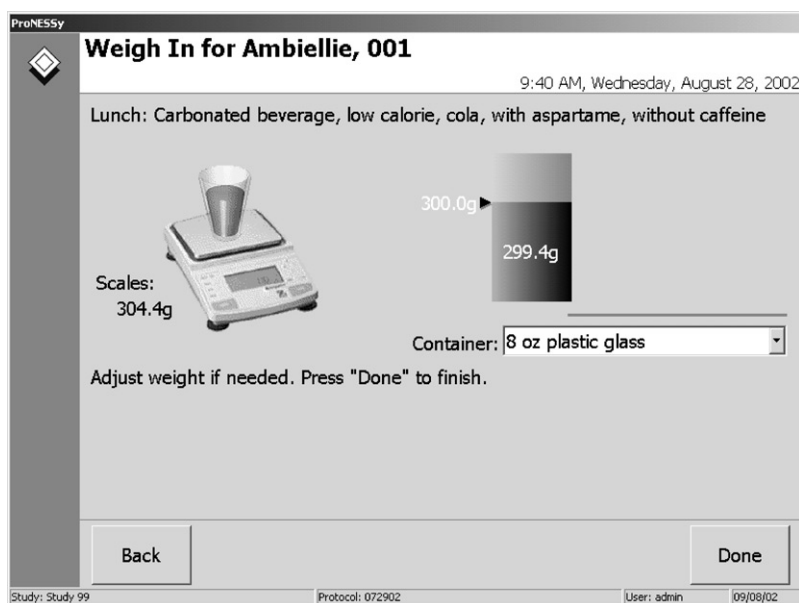


Fig. 2. ProNESSy Weigh-In of a food.



Fig. 3. Kitchen staff person performing a Weigh-In.

*Weigh-Out:* The Weigh-Out process is used to collect the necessary data for calculating the actual food amounts consumed by a subject. The kitchen staff member has the flexibility to decide the order for weighing out the foods and determines if the food should be weighed out as a single food or mixed food. Often, foods have been mixed together or moved from one container to another by the subject. *ProNESSy* provides instructions to ensure that each food's leftover amount or/and empty container weight is/are recorded into the ProNutra database. As each food is weighed out, a check mark appears in front of the food item. The kitchen staff can also enter text messages for the research dietitian. This is helpful should a problem arise requiring later adjustment by the dietitian. If the dietitian has confidence in the kitchen staff, there is an optional feature allowing for observation rather than weighing-out of completely eaten foods.

*Error detection and prevention:* Throughout *ProNESSy*, the system checks weights and actions against information established within *ProNutra* by the dietitian. This is done to determine if the data for the foods and/or containers “make sense”, and if it does not, then *ProNESSy* signals and/or queries the user. This feature both detects and prevents errors, thereby ensuring the accuracy of *ProNESSy*.

*Weigh-In and Weigh-Out status reports:* The Weigh-In, Weigh-Out, and Weigh-Back status reports are quality assurance reports to assist the dietitian and/or kitchen manager in determining if all foods have been processed using *ProNESSy*. The Weigh-In report is to be viewed before foods are served and the Weigh-Out report after foods have been processed following each meal/snack. The Weigh-Back report is an overall report providing weigh-in and weigh-out status on all of the scheduled foods as well as the leftover quantity of foods consumed. As soon as food weighing has been completed, the research dietitian can use *ProNutra* to summarize the nutritional composition of the foods consumed by subjects. Tools are also available to export the data to statistical packages for further analysis.

### 3. Conclusions

Through a customer request and eventually a partnership, *ProNutra's* capabilities have been integrated with those of *ProNESSy*. *ProNESSy* runs on an inexpensive computer equipped with a touch-sensitive screen and connected to an electronic scale. The information recorded with *ProNESSy* is stored via a LAN within the *ProNutra* database. Research dietitians can use *ProNutra* to plan, manage, analyze, and archive food and nutrient intake information, while dietetic support staff can use *ProNESSy* to accurately weigh and track foods prepared for research studies.

Because *ProNESSy* automates the food-weighing process, it helps reduce (or eliminate) potential kitchen production errors. Some research centers complement their full-time kitchen staff with temporary staff, while other centers have employee retention problems and rely heavily upon temporary staff. Because of less exposure to dietary kitchen procedures, temporary staff is more likely to commit errors. The *ProNESSy* “Weigh-In” mode, used during diet assembly, helps ensure that each subject is served the correct weight of specified foods. The “Weigh-Out” mode assists with tracking uneaten foods and ensures that correct food consumption amounts are calculated. Extensive error detection is used throughout the weighing process to prevent many errors that might otherwise occur as a result of human mistakes, such as selecting an incorrect food, recording an incorrect food weight or container, or overlooking uneaten food. Weigh status reports are available for use by the kitchen manager and dietitian to track the status of all foods served and eaten. Also, the combined software system has the capability of reducing dietary staff-training requirements. This is accomplished by providing interactive guidance to the kitchen staff and by converting study diets into simple electronic step-by-step instructions.

Overall, these features can potentially provide the dietitian with a labor- and time-saving as well as accuracy-enhancing tool for research studies. Potential research operation benefits include: offering researchers the flexibility of broadening or tightening study designs without increasing costs; increasing the accuracy and efficiency of research diet design, preparation, and weighing procedures; facilitating the use of valid nutrition research methodology without increasing cost expenditures; improving the ability to monitor subject response to nutrition protocols in a timely manner; and standardizing research methods among research centers, thus improving research data comparability between centers. Currently, seven research centers are beta testing *ProNESSy*. Thus far, *ProNESSy* is meeting expected accuracy and labor-saving expectations, but complete study results will not be available until 2004. This efficient usage of modern technology has the capability of providing researchers with needed tools for carrying out accurate and efficiently managed studies to extend the overall knowledge of nutrition, metabolism, and health, and also for maximizing their return from invested research dollars.

### Disclaimer

Mention of a trademark or proprietary product does not constitute endorsement by the US Department of Agriculture and does not imply recommendation over others that may be suitable.

## References

- Fong, A. K. H., & Kretsch, M. J. (1990). Nutrition evaluation scale system reduces time and labor in recording quantitative dietary intake. *Journal of the American Dietetic Association*, 90, 664–670.
- Kretsch, M. J., & Fong, A. K. H. (1990). Validation of a new computerized technique for quantitating individual dietary intake: Nutrition evaluation scale system (NESSy) versus the weighed food record. *American Journal of Clinical Nutrition*, 51, 477–484.
- Kretsch, M. J., & Fong, A. K. H. (1993). Validity and reproducibility of a new computerized dietary assessment method: Effects of gender and educational level. *Nutrition Research*, 13(2), 133–146.
- Kretsch, M.J., Gunn, M.A., & Fong, A.K.H. (1993). Method and system for the measurement of intake of foods, nutrients and other food components in the diet. US Patent Number 5,233,520.
- Weiss, R. (2000). ProNutra nutrient analysis system for metabolic studies. National Center for Research Resources Small Business Innovation Research Phase II grant R44 RR-11678-02A1.
- Weiss, R. (2001). Research and industry partnership in nutrient calculation software development. *Journal of Food Composition and Analysis*, 14, 253–261.